BS

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/042,509	01/08/2002	David J. Elliott	UV-103J	6607

7590 01/30/2004

IANDIORIO & TESKA
INTELLECTUAL PROPERTY LAW ATTORNEYS
260 BEAR HILL ROAD
WALTHAM, MA 02451-1018

EXAMINER	
SHECHTMAN, SEAN P	
ART UNIT	**PAPER NUMBER**
2125	4

DATE MAILED: 01/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/042,509	ELLIOTT ET AL.	
	Examiner	Art Unit	
	Sean P. Shechtman	2125	

-- The MAILING DATE of this communication appears on th cov r she t with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 April 2002*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 April 2002* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Claims 1-7 are presented for examination.

Information Disclosure Statement

2. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered (See page 3, lines 13-15 of the instant specification).

Drawings

3. The drawings are objected to because figure 3 fails to provide the appropriate unit labels on each axis of each graph. Furthermore, the specification fails to provide any explanation as to what these graphs depict. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

4. The disclosure is objected to because of the following informalities: The specification fails to provide a detailed description of figures 3 and 4. Appropriate correction is required.

Claim Objections

5. Claim 3 is objected to because of the following informalities: Referring to claim 3, line 2, examiner respectfully submits that "firs" should be rephrased "first". Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Pat. No. 5,590,051 to Yokozawa.

Referring to claim 1, Yokozawa discloses a predictive algorithmic model (Col. 1, lines 35-55) for simulating photocatalytic reactions (Col. 2, lines 1-24) comprising:

an input section for defining a plurality of variables (Col. 2, line 18; Col. 3, lines 58-60);

a calculation section for calculating a plurality of intermediate values and a plurality of output values (Col. 4, lines 1-11; Col. 4, lines 29-32); and

an output section for providing the plurality of output values of the photocatalytic reactions (Col. 4, lines 12-17; Col. 4, lines 31-40).

Examiner respectfully submits that a photocatalytic reaction is any reaction promoted or stimulated by light. Yokozawa teaches the vapor phase reaction models are based on a vapor phase reaction wherein material gases are decomposed by light so that a molecule which is liable to react (i.e., a reactant), is produced. Therefore the claim limitations are believed to be met.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,049,661 to Hayakawa in view of U.S. Pat. No. 5,246,529 to Fukasawa.

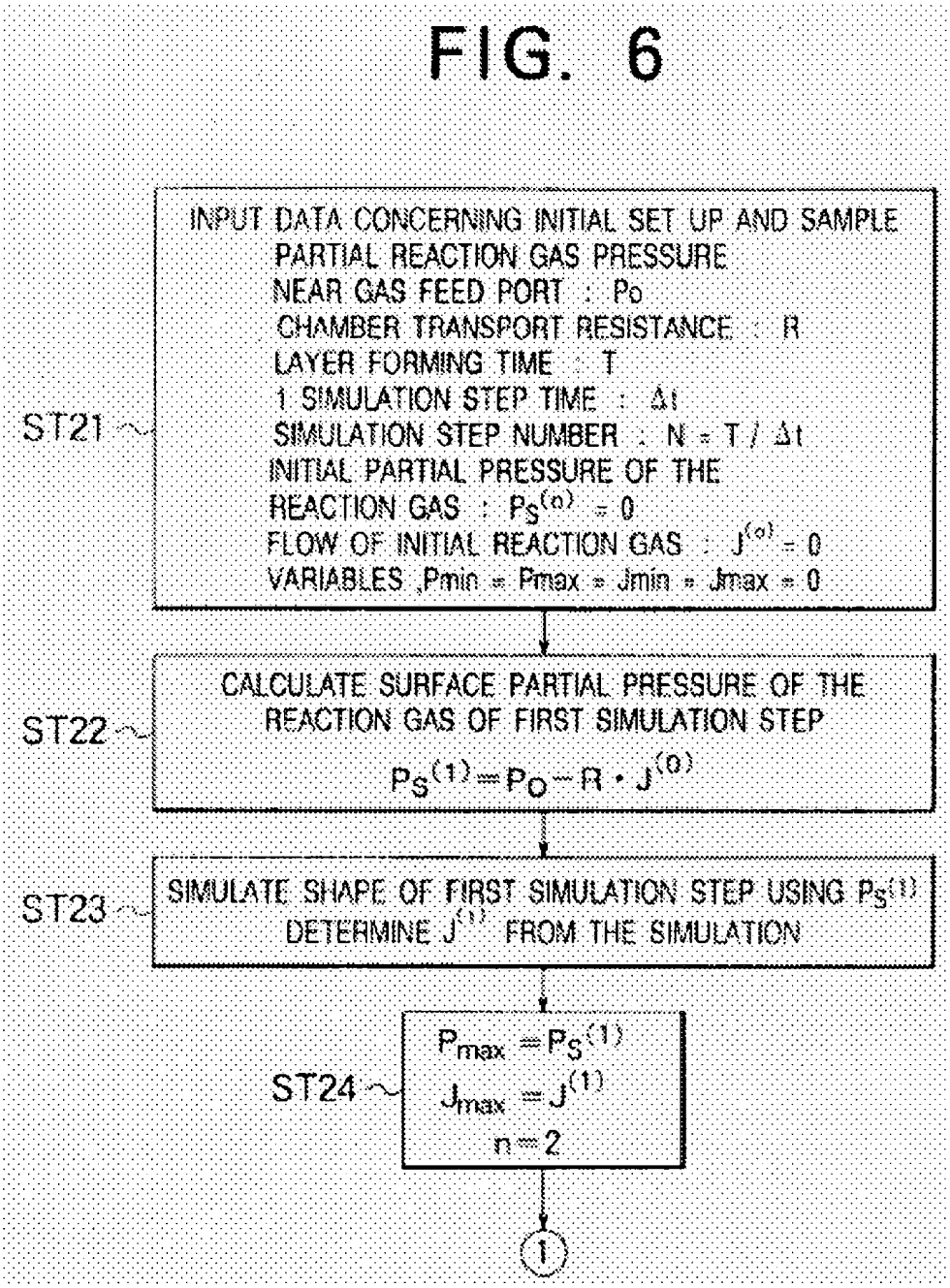
Referring to claim 1, Hayakawa discloses a predictive algorithmic model for simulating reactions of dry/plasma/chemical/reactive ion etching comprising:

an input section for defining a plurality of variables (See Fig. 6, element ST21);

a calculation section for calculating a plurality of intermediate values and a plurality of output values (See Fig. 6, element ST22); and

an output section for providing the plurality of output values of the dry/plasma/chemical/reactive ion etching reactions (See Fig. 6, element ST23-ST24).

FIG. 6



Hayakawa clearly teaches a predictive algorithmic model for simulating reactions of dry, plasma, reactive ion, or chemical etching/processing. Hayakawa goes on to teach how dry etching generates plasma and "the plasma are made to strike the surface of the sample so as to cause a chemical reaction" (Col. 1, lines 39-50). Examiner respectfully notes that applicant

clearly teaches plasma reaction chambers are those which use UV light and reactive gas processing for "all-dry" methods in page 3, line 5 – page 4, line 22 (See especially the termed "plasma reactor chambers referenced previously" in page 4, line 22).

Therefore, although Hayakawa clearly teaches that the reactions are modeled based on a plasma reactor chamber, Hayakawa fails to teach that the reactions being modeled based on the plasma reactor chamber are promoted or stimulated by light.

However, Fukasawa clearly teaches that plasma in plasma reaction chambers are promoted or stimulated by light (Abstract; Fig. 3 of '529).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to model the reactions in a plasma reactor chamber of Hayakawa to be promoted or stimulated by light as taught by Fukasawa.

One of ordinary skill in the art would have been motivated to combine these references because Fukasawa teaches stably and quickly radiating light to generate plasma at low gas pressure (Col. 1, lines 39-58 of '529).

8. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,049,661 to Hayakawa in view of "A Monte Carlo simulation of laser ablation during the laser pulse: Cl2(s) ablation dynamics for neutral beam etching" by Suzuki.

Referring to claim 1, Hayakawa discloses a predictive algorithmic model for simulating reactions of dry/plasma/chemical/reactive ion etching comprising:

an input section for defining a plurality of variables (See Fig. 6, element ST21);

a calculation section for calculating a plurality of intermediate values and a plurality of output values (See Fig. 6, element ST22); and

an output section for providing the plurality of output values of the dry/plasma/chemical/reactive ion etching reactions (See Fig. 6, element ST23-ST24).

Therefore, although Hayakawa clearly teaches that the reactions are modeled based on a plasma reactor chamber, Hayakawa fails to teach that the reactions being modeled based on the plasma reactor chamber are promoted or stimulated by light.

However, Suzuki clearly teaches that plasma in plasma reaction chambers are promoted or stimulated by laser ablation (See paragraph 1, lines 8-9). Furthermore, Suzuki teaches that a developed "plasma chemistry fluid model for a chlorine ablation plume". Suzuki goes on to teach how this "simulation includes the influence of the laser plume coupling on material removal at the surface" (See second paragraph).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to model the reactions in a plasma reactor chamber model of Hayakawa to be promoted or stimulated by a laser as taught by Suzuki.

One of ordinary skill in the art would have been motivated to combine these references because Suzuki teaches a more dissociated plume that can take advantage of the reactivity of the Cl radicals to relax the energetics requirements that potentially limit the use of ablation sources (See paragraph 1).

9. Claims 2 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 5,590,051 to Yokozawa as applied to claim 1 above, and further in view of U.S. Pat. No.

5,911,858 to Ruffner. Claims 2 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,049,661 to Hayakawa in view of U.S. Pat. No. 5,246,529 to Fukasawa, and further in view of U.S. Pat. No. 5,911,858 to Ruffner. Claims 2 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,049,661 to Hayakawa in view of "A Monte Carlo simulation of laser ablation during the laser pulse: Cl2(s) ablation dynamics for neutral beam etching" by Suzuki, and further in view of U.S. Pat. No. 5,911,858 to Ruffner.

Referring to claim 2, Yokozawa teaches the initial conditions for the simulation include the materials (Col. 4, lines 24-25) and photocatalytic reaction variables (Col. 3, line 65 – Col. 4, line 3).

Referring to claim 2, Yokozawa fails to teach that the initial conditions include wavelength. Referring to claim 7, Yokozawa fails to teach that the light is ultraviolet.

Referring to claim 2, Hayakawa fails to teach the initial conditions for the simulation include the materials, wavelength and photocatalytic reaction variables. Referring to claim 7, Hayakawa fails to teach that the light is ultraviolet.

However, referring to claims 2 and 7, Ruffner teaches analogous art, wherein initial conditions for a computer modeling program for a deposition profile are DUV or EUV wavelengths (Col. 12, lines 10-14 and 27-48 of '858). Ruffner goes on to teach the initial conditions for the simulation include the materials and photocatalytic reaction variables (Col. 6, lines 23-50; Col. 10, lines 53-66).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to combine teachings of Ruffner with those of Yokozawa or Hayakawa.

One of ordinary skill in the art would have been motivated to combine these references because Ruffner teaches photolithography system for employing a high precision multi-layered mirrors for use with either a DUV or EUV radiation source. Furthermore, Ruffner teaches the ability to predict and achieve a wide range of thickness profiles on substrates, and the ability to predict and accommodate necessary changes in sputter deposition rate as a result of plasma geometry (Col. 6, line 23 – Col. 7, line 10 of '858).

10. Claims 3-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 5,590,051 to Yokozawa as applied to claim 1 above, and further in view of U.S. Pat. No. 6,156,654 to Ho.

Referring to claim 3, Yokozawa teaches the model above, wherein the plurality of variables include gas pressure (Col. 5, line 54 – Col. 6, line 65; Col. 11, lines 7-18), first and second reactant types (Col. 4, lines 24-25), a material absorption coefficient (Col. 2, lines 34-41), an angle of incidence (Col. 7, lines 48-57), and first and second photochemical reaction parameters (Col. 4, lines 1-39).

Yokozawa fails to teach all the elements of claims 3-5.

However, referring to claim 3, Ho teaches analogous art, wherein the plurality of variables include at least a laser wavelength, a base fluence value, a fluence increment value, a first gas partial pressure, a partial pressure increment, a total pressure, first and second reactant types, a material absorption coefficient, a material threshold value, a material refractive index, an

angle of incidence, and first and second photochemical reaction parameters (Figs. 11-17; Cols. 3-6 of '654).

Referring to claim 4, Ho teaches the first laser wavelength is in the range of 100 to 400 nm (Col. 6, lines 10-31).

Referring to claim 5, Ho teaches analogous art, wherein the plurality of intermediate values include first and second optical gas densities, an incident fluence absorbed by gas, a reflected fluence, a total fluence absorbed by gas, a fluence absorbed in material, an ablation depth per pulse, and a photochemical component (Figs. 11-17; Cols. 3-6 of '654).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to combine teachings of Ho with those of Yokozawa.

One of ordinary skill in the art would have been motivated to combine these references because Ho teaches a method to improve thickness uniformity across a semiconductor wafer. Furthermore, Ho teaches using a laser to increase the efficiency between Ti and Si reactions (Col. 1, line 62 – Col. 2, line 30 of '654).

11. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 5,590,051 to Yokozawa as applied to claim 1 above, and further in view of U.S. Pat. No. 5,421,934 to Misaka. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,049,661 to Hayakawa in view of U.S. Pat. No. 5,246,529 to Fukasawa, and further in view of U.S. Pat. No. 5,421,934 to Misaka. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,049,661 to Hayakawa in view of "A Monte Carlo

simulation of laser ablation during the laser pulse: Cl2(s) ablation dynamics for neutral beam etching" by Suzuki, and further in view of U.S. Pat. No. 5,421,934 to Misaka.

Referring to claim 6, Yokozawa and Hayakawa fail to teach the predictive algorithmic model above, wherein the plurality of output values includes a total material removed and removal efficiency.

However, referring to claim 6, Misaka teaches analogous art, wherein the plurality of output values includes a total material removed and removal efficiency (Col. 3, lines 34-38; Col. 5, lines 1-14; Col. 7, lines 43-62; Figs. 5, 9, and 10 of '934).

Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to combine teachings of Misaka with those of Yokozawa or Hayakawa.

One of ordinary skill in the art would have been motivated to combine these references because Misaka teaches a new surface reaction model to simulate topological evolutions by taking into account the existence of absorbed radicals on the substrate surface (Abstract of '934). Furthermore, Misaka teaches a topological simulator that can determine optimum etching conditions (Col. 3, lines 8-57 of '934).

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents or publications are cited to further show the state of the art with respect to modeling of a laser chemical vapor deposition process.

U.S. Pat. No. 5,060,595 to Ziv (Col. 7, line 35 – Col. 8).

The following patents or publications are cited to further show the state of the art with respect to dry etching and/or plasma-assisted etching simulators

"Dry Etching Topography Simulator with a New Surface Reaction Model: MODERN", by Misaka.

U.S. Pat. No. 6,199,029 to Ohta.

The following patents or publications are cited to further show the state of the art with respect to a laser ablation process model.

U.S. Pat. No. 5,523,543 to Hunter (Col. 6, lines 24-52).

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sean P. Shechtman whose telephone number is (703) 305-7798. The examiner can normally be reached on Monday-Friday from 9:30am to 6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo P. Picard, can be reached on (703) 308-0538. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-9600.

SPS

Sean P. Shechtman

January 21, 2004

LEO PICARD
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100